Validation of LS1 model for delamination propagation criterion at 0°- theta° interfaces

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Validation du modèle LS1 pour la propagation d'un délaminage aux interfaces 0°/θ°

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The aim of this paper is to propose an efficient and accurate alternative to the computationally expensive three-dimensional finite element method (3D-FEM), for analyzing delaminated multilayered plates under classical loads. Many of the existing models deal with the analysis of multilayered structures only in the non-delaminated state.

The first part of the present study extends the application of a layerwise stress model, called the LS1 model, to delaminated multilayered plates subjected to mode I and/or II loads.

The analytical LS1 solutions are derived for general non-delaminated and delaminated multilayers and compared to 3D finite element solutions along with the results from the 2D-FEM code based on the LS1 (fig. 1). The comparison gives a good agreement between the LS1 and 3D-FE models except near singularities (free edges, crack tips,...).

In order to overcome this drawback, a refinement approach, called the refined LS1 [1], will be shortly presented. The comparison between the refined LS1 and 3D-FE models reveals an excellent agreement, even in the vicinity of singularities, in terms of interlaminar stresses and strain energy release rate.

An interfacial stress based criterion arising from an energy power-law [2] one by using the LS1 model [3] will be proposed. Mode separation will be analytically deduced from the interfacial stresses (tab. 1).

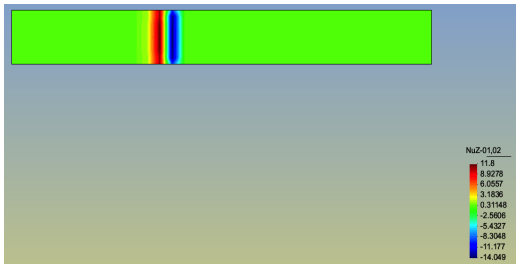

Fig. 1. Interfacial pullout for ADCB18 test specimen (MPa)

	a(mm)	85	90	95	100	105
ADCB18	P(N)	34.17	31.93	31.31	29.56	28.73
	$G_I - EXP(J/m^2)$	321	314	337	332	346
	$G_I - FE(J/m^2)$	327	319	340	335	347
	$G_I - 2DFE(J/m^2)$	321	314	335	331	344
	$G_{II} - EXP(J/m^2)$	59	58	62	61.5	64
	$G_{II} - FE(J/m^2)$	46	45	48	47	49
	$G_{II} - 2DFE(J/m^2)$	59	58	62	61.5	64

Tab. 1. Average experimental and finite element values for ADCB18 test specimen

Références

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